UNIVERSITY OF NOTTINGHAM

DEPARTMENT OF PSYCHOLOGY

THE MOBILITY OF BLIND PEOPLE

A short progress report

Programme Grant G972/207 (ii)
Medical Research Council
Department of Health & Social Security.

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THE MOBILITY OF BLIND PEOPLE

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INTRODUCTION .

The aim of the research programme is to identify the problems experienced by visually handicapped people during independent mobility and to investigate possible solutions to these problems. The main programme is constituted of a number of projects, each of which deals with some aspect of the two major problem areas in mobility. These areas have been defined as pedestrian protection and pedestrian orientation. Projects concerned with pedestrian protection include the design, production and evaluation of an aid intended to provide the user with information about the presence of obstacles in the near environment and the assessment of the efficacy of similar aids produced by other research organisations.

In the area of pedestrian orientation, individual projects include an investigation of mobility problems experienced by visually handicapped people whose uncorrected hearing is inadequate to allow accurate sound localisation, and the design, production and evaluation of maps as a means of providing information for geographical orientation.

In addition, special interest is now being directed towards the problems of protection and orientation experienced by visually handicapped people with some useable vision. At a more general level, one project is concerned with a description of the mobility capacity of visually handicapped individuals in an urban area and an assessment of mobility potential (given the delivery of currently available and projected aids). In addition, our early studies on the adequacy of specific mobility training programmes as mediators of life style changes, have been extended to include general rehabilitation programmes.

When information derived from the various projects suggests potential solutions to mobility problems, details are disseminated to mobility practitioners for application. Follow up studies are usually instituted to monitor the success of the aid or system provided or proposed.

1. PEDESTRIAN PROTECTION

(a) The Nottingham Obstacle Detector

Our early assessments of the usefulness of the Ultra Sonic Aid (Kay, 1964) suggested that visually handicapped people were unable to extract relevant mobility information from its complex and infinitely variable auditory display, particularly in multiple target situations (Armstrong, 1973). The Nottingham Obstacle Detector was developed to provide the user with clear and unambiguous information about the presence and distance of a target. A description of the device is given in Appendix I. A second generation aid, of improved design, is currently being developed. Twenty of these aids have now been constructed and of these, fifteen have auditory displays whilst the remainder will be modified to provide a discreet tactual display. The fifteen aids with auditory displays have been placed with visually handicapped people as part of an evaluation programme.

Because the Obstacle Detector cannot be depended on to give warning of impending down kerbs or the presence of overhanging obstacles, it has been designated as a secondary aid to be used in conjunction with an established primary aid, such as long cane or guide dog. Although we have developed procedures for the measurement of total mobility performance (Armstrong, 1975), no appropriate assessment technique is available for performance with secondary aids. Specific questions about the level of safety or degree of efficiency which can be asked of mobility performance when a primary aid is being used are not appropriate to an intermittently used secondary aid.

In the current evaluation, we intend to gather data on the amount and type of use of the aid from daily diary records kept by the users. An evaluation of the five devices with tactile outputs will involve visually handicapped people with and without hearing loss.

A headmounted version of the Nottingham Obstacle Detector is being considered as a viable alternative to the more complex and very expensive Binaural Sonic Aid (Kay, 1973). The purpose

of such a comparison would be to determine whether or not the high expense of providing stereophonic information can be justified in terms of improved mobility performance or strong user preference.

(b) Evaluation of other mobility aids

Research groups elsewhere continue to provide prototype mobility aids for evaluation. Our techniques for measuring mobility performance (as a means of determining the efficacy of a particular aid) have attracted much interest and we have recently completed an assessment of the Swedish Laser Cane. In addition the Sonospec from Japan has been made available for evaluation and two Sonic Guides (Mk II) will soon be added to two existing devices in our on going study of the long term effects of using that device.

(c) Extending currently established evaluation procedures.

The current evaluation procedure has lacked an adequately validated measure of the level of psychological stress experienced by the pedestrian. Heart rate was abandoned as a measure because it failed to reflect moment-to-moment fluctuations in stress level resulting from difficult mobility situations. However, average stride length does seem to be correlated with complexity of situation and a comparison of average stride length and subjective stress ratings bears this out. Experimentation to this point has been restricted to comparing stress ratings with average stride length over quite long route sections. However, an examination of the relationship between these ratings and stride length over much shorter distances (particularly when complex situations are involved) is planned.

2. PEDESTRIAN ORIENTATION

(a) The Hard of Hearing Blind

Practical mobility training is firmly founded on the assumption that the visually handicapped person has adequate binaural hearing to allow the localisation of distant sound sources for orientation purposes. In consequence, visually handicapped people with a significant hearing loss in one or both ears are not normally considered suitable as either long cane users or guide-dog owners. Since the majority of visually handicapped people are elderly (Gray and Todd, 1968) it is likely that, as a result of ageing processes alone, a high proportion of the population will have some degree of hearing loss.

Our research in this area has been aimed at examining the improvement in sound localisation and, consequently in mobility, which results from providing the hard-of hearing individual with various hearing aids and aid combinations (Heyes & Ferris, 1975). Much of the laboratory work is now complete and we are able to conclude that a single post-aural hearing aid will allow more accurate localisation of sounds than will a chest mounted aid. We have also concluded that, for both post-aural and chest mounted aids, two aids (presenting binaural information) are better than one alone. In addition we have shown that post-aural aids are capable of improving localisation for individuals with a hearing loss as high as 80dB. In terms of decreasing practical usefulness, aid systems can be ranked as binaural post-aural aids, monaural post-aural aids, binaural chest mounted aids and monaural chest mounted aids.

It is our recommendation that, for all visually handicapped individuals with a hearing loss of up to 75 dB, a binaural post-aural system should be provided.

It is now our intention to extend the study into practical situations in order to establish the effectiveness of the preferred hearing aid system in providing adequate sound information for mobility purposes. It is hoped that, in

future, mobility practitioners will be able to provide standard mobility training to individuals who, because of their additional handicap, were not previously considered able to accept training.

(b) The design and construction of maps

With the completion of our experimental work on the selection of suitable symbols to represent point, line and areal features on raised maps, we have concentrated on the development and evaluation of a kit of map making parts which includes these symbols along with the materials to allow the construction of master maps from which plastic copies can be taken (James, 1975). The aim has been to provide, in a single box, everything which the mobility practitioner needs in order to make up tactile maps for his visually handicapped clients. To the present, over one hundred kits have been distributed within the United Kingdom and also to the United States, West Germany, Yugoslavia, Denmark, Sweden, Norway, Brazil, Australia and New Zealand.

Perhaps the most significant aspect of this development is not the kit itself but rather that a degree of standardisation in symbolisation has been achieved simply by making a set of symbols readily available.

Because many potential map users in the visually handicapped population do not read braille, we have examined the possibility of providing maps which use raised number for coding. Field studies indicate that provided that the previously determined minimum number, height and size is not exceeded, non braille readers can read and use maps as effectively as braille readers.

3. LOW VISION

A large proportion of the visually handicapped population has some degree of useable vision. Since even the smallest amount of vision can lead to a significant improvement in mobility performance, it is important that the individual is provided with appropriate aids and training to encourage and enable him to maximise the use of his remaining sight.

Although clinical assessment techniques are now well developed, it is generally accepted that clinical data alone is a poor predictor of performance for either reading or mobility tasks.

In order to assess the effectiveness of a particular aid (optical or otherwise) some procedure which relates to performance of defined tasks (i.e. a functional assessment) is required. In the case of reading with low vision aids, the task itself is easy to define, the test conditions are easy to control and criteria for success easy to establish. However, the assessment of those aspects of mobility performance possibly affected by the use of low vision aids is a more complex matter.

It is our intention to gather mobility performance data for low vision pedestrians using our standard mobility evaluation techniques and to establish if any modification to this established approach is necessary in order to give a comprehensive and meaningful description of low vision performance. Additionally, more artificial studies may be necessary in order to allow testing of reading (e.g. road signs, bus numbers etc) at a distance and a special study of mobility performance as a function of ambient light level will be undertaken.

4. A SURVEY OF MOBILITY CAPABILITY AND POTENTIAL

The survey carried out by Gray and Todd (1968) revealed something of the mobility and reading habits of the visually handicapped population. The Gray and Todd study concentrated mainly on amount of independent movement and provided little information on either the mobility capacity or potential of the population.

We have initiated a detailed survey of the visually handicapped population of the City of Nottingham (approximately 1000 people) which will establish current mobility levels and also identify the potential for improvement in mobility performance. The essential aim of the survey is to establish the likely demand for those mobility aids which are currently available (e.g. long cane, guide-dog, stereophonic hearing aids, raised maps etc) and also to indicate the need for additional services (e.g. specialised training for the elderly, hard of hearing blind etc). The survey procedure will include measurement of mobility performance, audiometric and tactual sensitivity testing.

5. MEASURING SELF ESTEEM CHANGES RESULTING FROM REHABILITATION PROCEDURES

Our previous work in this area has demonstrated an increase in the self esteem of individuals as a result of participating in the guide dog training programme. We have now extended this study to include individuals participating in general rehabilitation programmes (as opposed to specific mobility training courses) in order to establish if such programmes bring about similar improvements.

Using our previously developed self-esteem schedule, we have established the level of self-esteem for clients arriving at the Royal National Institute for the Blind Rehabilitation Centre at Torquay. The schedule will be readministered at the end of the rehabilitation period in order to establish if any increase in self-esteem has been brought about.

6. DISSEMINATION OF INFORMATION

Where applicable, the outcome of research projects is communicated to mobility practitioners and other research groups. Information on the design and production of maps has been made available to practitioners through the first of a series of monographs (Armstrong, 1973) and practical courses in map making have been arranged to provide in-service training for mobility officers. We have now completed a 47 minute video-tape on maps which has already been sold to a number of organisations in this country and abroad. Information on the prescription of stereophonic hearing aids for the hard of hearing blind and details of appropriate training will be disseminated shortly.

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CURRICULUM VITAE

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APPENDIX A.

INFORMATION SHEET 04/75-04/JDA
UNIVERSITY OF NOTTINGHAM
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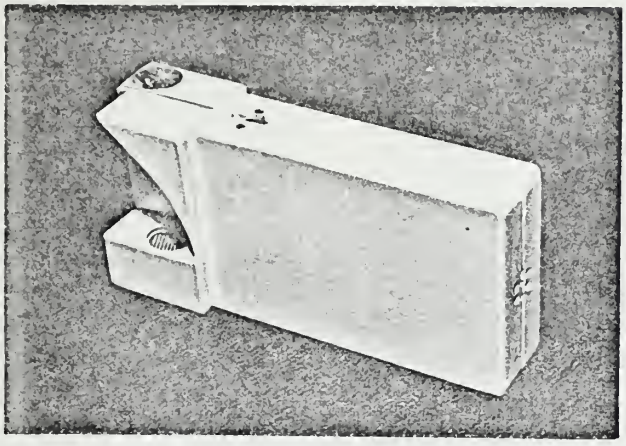
BLIND MOBILITY RESEARCH UNIT

THE NOTTINGHAM OBSTACLE DETECTOR

A new electronic mobility aid, which has been developed by the Blind Mobility Research Unit, is currently undergoing field trials. Although a number of obstacle detectors have been developed in the past, this aid incorporates a number of features which, it is believed, will make it very acceptable to the visually handicapped. The aid is a small hand held ultrasonic detector which signals the presence of obstacles up to a distance of 8 feet ahead of the user.



It transmits pulses of high frequency sound (40 kHz) ahead of the user and any obstacle which falls within its ultrasonic beam reflects some of this energy back to the device receiver. The distance of the obstacle is determined by the length of time that an individual sound pulse takes to travel from the aid, to the obstacle, and back again. In the interests of simplicity at the display, the device has only eight possible outputs; each output corresponding to a small range of obstacle distances. An obstacle which lies at any distance between zero and 12 inches gives a single unique output at the display. An obstacle anywhere between 12 inches and 24 inches will give another unique output, and so on. Thus, the maximum range of the device (84 inches) is subdivided into eight 12 inch zones, each of which has a unique signal assigned to it.

Although it would be possible to assign any type of physical signal to each of the eight outputs, the present aid has an auditory display which utilises the eight notes of a major scale (with the lowest note representing an obstacle in the nearest distance zone). Experiences with the aid so far indicate that the users have no difficulty in learning the major scale coding and find it exceptionally easy to know when to stop on approaching obstructions. An alternative display, using tactual coding, is currently being developed so that the aid can also be used by the deaf/blind. As a further simplification, the aid signals the position of the nearest obstacle only. This arrangement avoids the confusion which results when two or more obstacles fall in the ultrasonic beam.

The Nottingham Obstacle Detector (NOD) is intended to be a secondary mobility aid which will supplement, rather than replace, the user's cane or dog. The aid would normally be kept in the user's pocket until there was a need to make a check on the presence and distance of obstacles/landmarks. It is hoped that the aid will be of value to cane users, guide dog owners and individuals with some residual vision (as a means of distinguishing between solid obstacles and shadows). Alternatively, it could be used as a primary aid where movement is restricted to the inside of a building.

The aid is not yet commercially available although it is hoped that it will be so within 18 months.

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